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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/825,946	04/05/2001	Junji Noguchi	501.39932X00	5570

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EXAMINER

VU, HUNG K

ART UNIT	PAPER NUMBER
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2811

DATE MAILED: 05/22/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/825,946	NOGUCHI ET AL.	
	Examiner	Art Unit	
	Hung K. Vu	2811	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 07 March 2002.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-45 is/are pending in the application.
- 4a) Of the above claim(s) 1-19 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 20-45 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) Paper No(s). _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449) Paper No(s) <u>2</u> | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Election/Restrictions

1. Applicant's election without traverse of Invention of Group II, Claims 20-45, in Paper No. 6 is acknowledged.

Claims 1-19 are withdrawn from further consideration pursuant to 37 CFR 1.142(b) as being drawn to a nonelected Invention, there being no allowable generic or linking claim.

Election was made **without** traverse in Paper No. 6.

Claim Objections

2. Claim 20 is objected to because of the following informalities: In claim 20, line 3, "chip" should be changed to "substrate" for clarity. Appropriate correction is required.

Claim Rejections - 35 USC § 112

3. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 20-45 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

In claim 20, there is no method recitation steps cited in the rejected claim. Therefore, there is unclear as to how the device is formed.

Claim Rejections - 35 USC § 102

4. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in-

(1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effect under this subsection of a national application published under section 122(b) only if the international application designating the United States was published under Article 21(2)(a) of such treaty in the English language; or

(2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that a patent shall not be deemed filed in the United States for the purposes of this subsection based on the filing of an international application filed under the treaty defined in section 351(a).

Claims 20, 22, 31-34, and 42, in compliance with 35 USC 112, 2 paragraph, are rejected under 35 U.S.C. 102(e) as being anticipated by Maekawa (PN 6,171,957). Note Figures 1(a)-2 of Maekawa.

Maekawa discloses a method of fabricating a semiconductor integrated circuit device comprising,

a semiconductor substrate (1) having a first main surface,

a first insulating film (2) formed over the first main surface of the semiconductor substrate,

an embedded interconnection slot (3) formed over the first insulating film main surface,

a connecting hole provided in a bottom surface of the embedded interconnection slot, and connected to a lower conducting layer (a semiconductor element, not shown),

a conducting barrier film (6) formed over surface region of the bottom surface and side surface of the embedded interconnection slot and the connecting hole,

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an embedded metal interconnection layer (5) having copper as its main component embedded in the interconnection slot and in the connecting hole in which the conducting barrier film is formed,

a cap insulating film (silicon nitride, 4) formed so as to cover the embedded metal interconnection layer and the upper surface of the first insulating film, wherein,

the concentration of components other than copper in the embedded metal interconnection layer in the finished semiconductor chip does not exceed 0.8At% (0.1 wt% Si), and

the purity of copper in the metal film when an embedded metal film having copper as its principal component is formed to form the embedded metal interconnection layer, is not less than 99.999%

With regard to Claim 22, Maekawa discloses the metal film is formed by sputtering using a target wherein the purity of copper is not less than 99.999%.

With regard to Claims 32-34, Maekawa discloses the concentration of components other than copper does not exceed 0.05At%.

With regard to Claim 42, Maekawa discloses there might be no conducting barrier film.

Claim Rejections - 35 USC § 103

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 21, 23, 28-31, 35-41, and 43-45, in compliance with 35 USC 112, 2 paragraph, are rejected under 35 U.S.C. 103(a) as being unpatentable over Maekawa (PN 6,171,957).

With regard to claims 21 and 23, Maekawa discloses the copper having purity of 99.999 wt% or higher. Maekawa does not disclose the copper having purity of 99.9999 wt%. However, it would have been obvious to one having ordinary skill in the art at the time the invention was made to form the copper having purity of 99.9999 wt% in order to produce the small line width and to increase the speed of the device to meet the performance goal.

With regard to claim 28, Maekawa discloses performing the CMP to the first metal film.

Maekawa does not disclose the CMP is abrasive particle-free CMP. However, it would have been obvious to one having ordinary skill in the art at the time the invention was made to perform the abrasive particle-free CMP in order to prevent the surface damage to the first insulating film.

With regard to claims 29-31, 35-41, and 43-45, although Maekawa does not teach the exact the thickness of the conducting barrier film, the concentration of other components in copper, the mass ratio of abrasive particles, and the width of the embedded interconnection slot, as that

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claimed by Applicants, however, it would have been obvious to one having ordinary skill in the art at the time the invention was made to form the conducting barrier film, the concentration of other components in copper, the mass ratio of abrasive particles, and the width of the embedded interconnection slot, having a desired thickness, concentration, the ratio, and height, since it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. In re Boesch, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

6. Claims 24-27, in compliance with 35 USC 112, 2 paragraph, are rejected under 35 U.S.C. 103(a) as being unpatentable over Maekawa (PN 6,171,957) in view of Ngo et al. (PN 6,348,410).

Maekawa discloses the metal film is planarized by chemical mechanical polishing. Maekawa does not disclose the first main surface of the semiconductor substrate is plasma treated in an atmosphere of a gas having reducing properties prior to forming a cap insulating film. However, Ngo et al. discloses forming a metal film(236) is planarized by chemical mechanical polishing and a first main surface of the semiconductor substrate is plasma treated in an atmosphere of a gas having reducing properties prior to forming a cap insulating film (224). Note Figure 3 and Col. 5, lines 47-57 of Ngo et al.. Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to plasma treat the first main surface of the semiconductor substrate of Maekawa in an atmosphere of a gas having reducing properties prior to forming a cap insulating film in order to suppress hillocks formation.

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With regard to claims 25-27, Maekawa and Ngo et al. disclose the gas atmosphere comprises hydrogen (ammonia) and/or nitride hydride as its principal component element.

Conclusion

7. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Hung K. Vu whose telephone number is (703) 308-4079. The examiner can normally be reached on Mon-Thurs 7:00-5:30, Eastern Time.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Tom Thomas can be reached on (703) 308-2772. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 308-7722 for regular communications and (703) 308-7722 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

Vu

May 18, 2002



**TOM THOMAS
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 2800**